ECOSYSTEM STATUS INDICATORS

Seabirds

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Trends in Abundance and Productivity

Breeding populations were estimated to contain 36 million individuals in the BS and 12 million individuals in the GOA; total population size (including subadults and nonbreeders) is estimated to be approximately 30% higher. Five additional species occur in Alaskan waters during summer and contribute another 30 million birds. More recent analyses of updated colony data indicated that the eastern Bering Sea (EBS) supports about 20.3 million breeding seabirds, whereas the GOA has 7.2 million (Stephensen and Irons 2003).

Some seabirds are highly clustered into a few colonies, and 50 % of Alaska's seabirds nest in just 12 colonies, 10 of which are in the EBS (Stephensen and Irons 2003). The USFWS and USGS-BRD monitor selected colonies on rotating schedules, described in detail in Dragoo et al. (2004) (see also, NPFMC 2002). Discussion of factors that influence seabird populations was presented in the 2002 Ecosystems chapter (NPFMC 2002). For detailed summaries of seabird chronology, breeding success and population trends for species at specific sites refer to Dragoo et al. (2004), which includes data up to 2002. Below, we summarize data presented in Dragoo et al. (2004), with a focus on broad regional trends, using each species x site as a population sample (Figures 95-97). In addition, we examined the regional trends relative to three feeding guilds of seabirds: planktivores (birds that eat primarily macro-zooplankton and invertebrates), surface piscivores (birds that forage primarily from the surface to catch fish), and diving piscivores (birds that forage by diving into the water column to catch fish). These guilds are simplified for this exercise, since most birds consume both plankton and fish to some degree. For this report, planktivores refers to storm-petrels and auklets, surface piscivores refers to kittiwakes and gulls, and diving piscivores refers to murres, puffins, rhinocerous auklets, and cormorants.

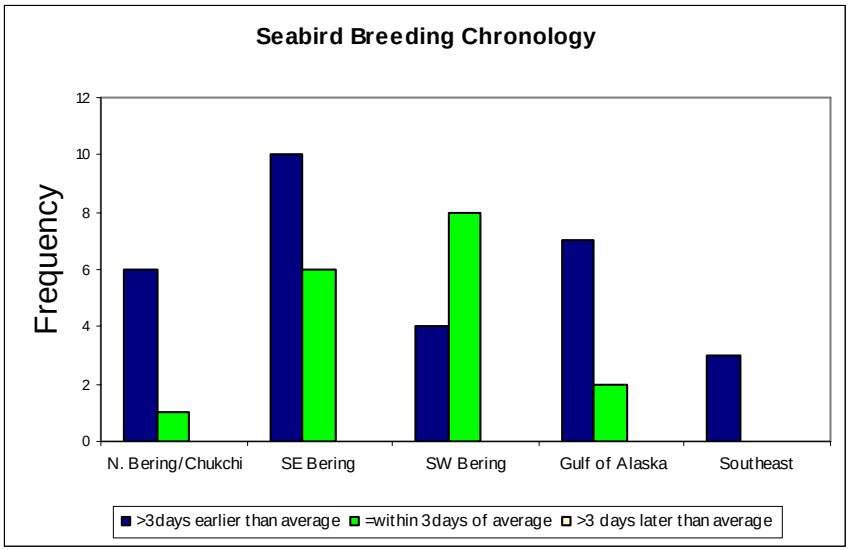
Overall, breeding chronology (Figure 95) was early or typical in 2002 for most regions and species within feeding guilds, and in fact there were no cases of later than normal chronology. Among the planktivores, surface feeders (storm petrels) were earlier than normal while the diving feeders (auklets) tended to be average (Dragoo et al. 2004), which reflects the trends in piscivores. Surface-feeding piscivores in particular tended to be early in chronology throughout the Bering Sea as well as the GOA. Diving piscivores, while also showing early breeding for many colonies, tended to have average breeding initiation among other colonies, particularly in the SE Bering. A trend of earlier breeding in seabirds has been noted throughout the North Pacific, and may be linked to climate changes affecting spring plankton blooms, which may affect forage fish availability (Root et al. 2003).

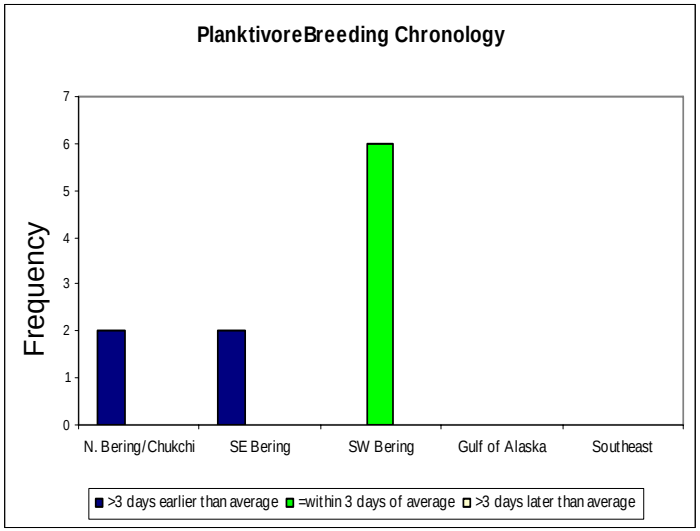
Seabird productivity in 2002 (Figure 96) was variable throughout regions and among species. Planktivores, concentrated in the SW Bering, tended to have average productivity, although the auklets in the N. Bering (St. Lawerence Island) were above average. Surface feeding piscivores (most cases being black-legged kittiwakes) were mostly above average, particularly in the SE Bering and GOA, while those in the Chukchi and N. Bering had some below average samples (site x species). Productivity of diving

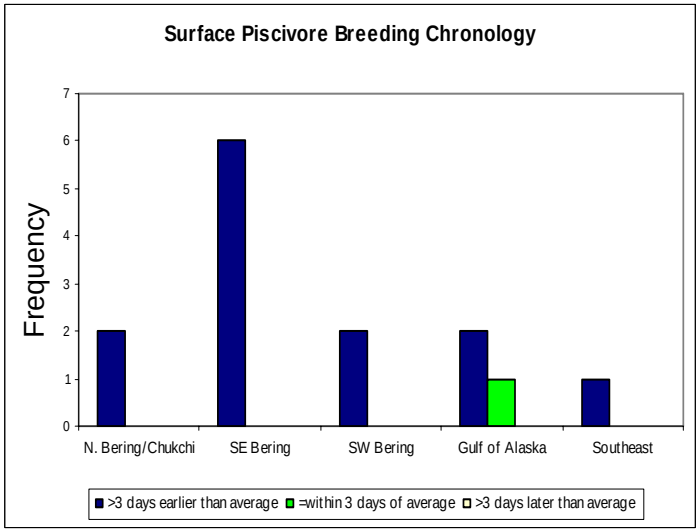
piscivores was more mixed, with 16 of 39 cases (41%) showing below average success, concentrated in the SE and SW Bering. The above average samples were also concentrated in the SE Bering and the GOA. The remaining 10 samples of average productivity occurred from the SE Bering to Southeast.

Although there is limited long-term productivity data for the GOA and SEAK, there is some suggestion that between ~ 1994-97, GOA seabirds did poor or average while more SEAK seabirds did well (Table 24). In contrast, during 1999-2002, seabirds did better in GOA than in SEAK, and seabirds in both regions had low or average productivity in 1998. Productivity data suggests that in 1989-97, most SEBS populations did poorly, whereas, most SWBS populations did well (except surface piscivores, which generally did poorly 1993-1996). This switched after 1998, when SEBS seabirds had higher productivity and most SWBS seabirds had low productivity (Table 25). For seabirds in Alaska, it is apparent that, while there may be some regional and decadal patterns, changes in seabird productivity are not similar across regions or often not among feeding guilds within the same region. Even where predominate patterns may indicate generally poor or good years regionally, there are usually species or colonies that are exceptions (see Dragoo et al. 2004), indicative of local environmental effects. Although general large-scale patterns are weakened by such species and colony effects, there is some suggestion that major regions within both the Bering Sea and the GOA may be in opposition in terms of environmental conditions beneficial to seabird productivity. (This is speculative and requires further investigation).

Changes in seabird populations (Figure 97) are less subject to annual fluctuations, since adults are long-lived and usually return to the same breeding colony. Because changes observed in a single year may not be meaningful, Dragoo et al. (2004) describe population trends by exponential regression models, with inclusion of 2002 data. Through 2002, declining seabird populations were the minority (18 of 88 cases), and most prevalent in the SE Bering (which includes the Pribilof Islands) and GOA (Figure 97). The highest proportion of increasing trends occurred in the SW Bering (7 of 21 cases). However, in all regions, the majority of species showed no discernable trend. Planktivores were stable or increasing at all monitored sites. Among surface piscivores most populations were stable, with decreasing trends apparent mainly in the SE Bering and to lesser extent in the GOA. The only positive trends occurred in the SW Bering and GOA. Diving piscivores showed more variability, with cases of negative trends strongest in the SE Bering and GOA, positive trends occurring in all regions, but the majority of populations stable.







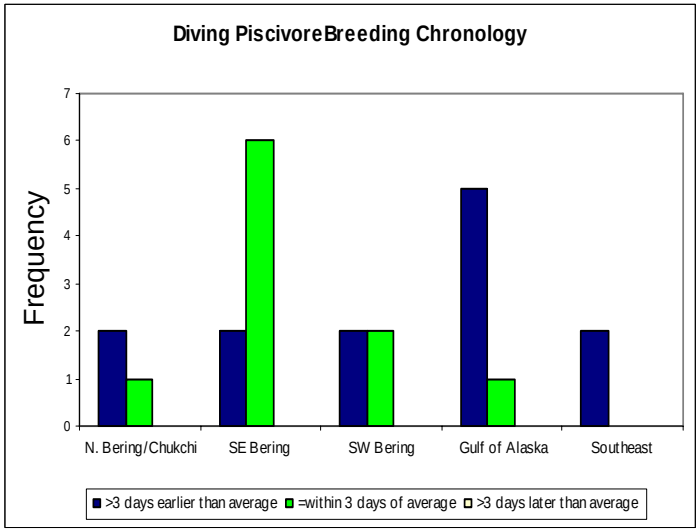


Figure 95. Seabird breeding chronology (by region and for three feeding guilds) for species monitored at selected colonies in Alaska in summer 2002. Frequency is the number of samples (species x site) for each region, showing earlier than average, average, or later than average dates for breeding. Chronology usually used hatch dates. Data are from Table 37 in Dragoo et al. 2004.

Table 24. Average productivity anomalies for seabird species averaged across species in three feeding guilds (surface piscivores (SP), diving piscivores (DP), and surface planktivores (PL)) of the north Bering Sea/Chukchi Sea, southeast Bering Sea (SEBS) and southwest Bering Sea (SWBS). Anomalies were calculated as the estimated productivity for a given year minus the mean productivity over the whole time series and divided by the standard deviation. Anomalies were divided into 7 categories for display purposes (see legend).

Region	Guild	Species	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
NBS/Chukchi	SP	BLKI		.	-	.	.	++	+	+	+	+	-	-	.	+	.	-	.	.	-	.		-	.	.	.	.	+	-	.
NBS/Chukchi	DP	COMU															.		+	-				-					+	.	-
NBS/Chukchi	DP	TBMU															.		.	-				+	-	-	.		.	+	-
NBS/Chukchi	PL	CRAU																											.	-	+
NBS/Chukchi	PL	LEAU																											.	-	+
SEBS	SP	RLKI		.	+	+	-	.	.	-	-	-	-	-	.	-	+	-	.	+	+	.	.	-	-	.	+	-	+	-	+
SEBS	SP	BLKI		+	+	+	.	+	+	.	-	-	-	-	.	-	+	-	.	.	+	.	-	-	-	.	.	-	+	-	++
SEBS	SP	GWGU																						-	-	+	+	-	.	+	.
SEBS	DP	COMU			.		+			-			-	+	.	+	+	.	.	+	.	+	.	+	.	-	--	-	+	.	.
SEBS	DP	TBMU			++	.	+			---			-	+	-	+	+	.	.	+	.	+	.	.	.	.	-	.	+	.	.
SEBS	DP	TUPU																						.	-	-	-	.	+	+	+
SEBS	DP	RFCO			.	.	.							.	.	.	.	.	-		-	-	-	-	.	-	+	.	+	.	+
SEBS	DP	PECO													.	.	+	.	.	+	++	+	+	-	-	-	-	-	-	.	+
SEBS	PL	LHSP																						+	-	-	.	+	+	+	--
SEBS	PL	FTSP																						.	-	-	.	+	.	+	+
SWBS	SP	BLKI															+	-	+	.	++	-	-	-	.	+	.	-	.	-	.
SWBS	SP	RLKI															+	.	++	.	+	-	-	-	.	.	.	-	+	-	.
SWBS	SP	GWGU																			.	-	-	.	.	++	.	.	-	-	+
SWBS	DP	HOPU											-	-	-	-	--	+	.	.	.	+	+	+	+	+	-	-	.	+	-
SWBS	DP	TUPU															-	+	.	-	+	+	.	+	+	-	-	.	++	.	-
SWBS	DP	COMU																							++	+	.	-	.	.	.
SWBS	DP	TBMU															+	.	+	.	-	+	.	+	+	+	-	-	.	-	.
SWBS	DP	PECO	+																++		-	-	+	.	.	+	-	.	+	.	.
SWBS	DP	RFCO																							.	.	.	-	+	+	.
SWBS	PL	PAAU																		.	+	.	.	+	+	.	+		.	--	-
SWBS	PL	WHAU																	.	-	.	.	+	+	+	+	.		-	--	-
SWBS	PL	CRAU															--		-	-	+	+	.	+	.	.	+	+	.	-	.
SWBS	PL	LEAU															.		--	+	.	.	-	++	+	.	-	-	.	.	.
SWBS	PL	LHSP	--	--	--													.	+	+	.	.	+	+	.	+	+	.	.	.	.
SWBS	PL	FTSP	-	--	-													-	+	+	+	.	+	+	.	-	+	.	+	.	+

Legend

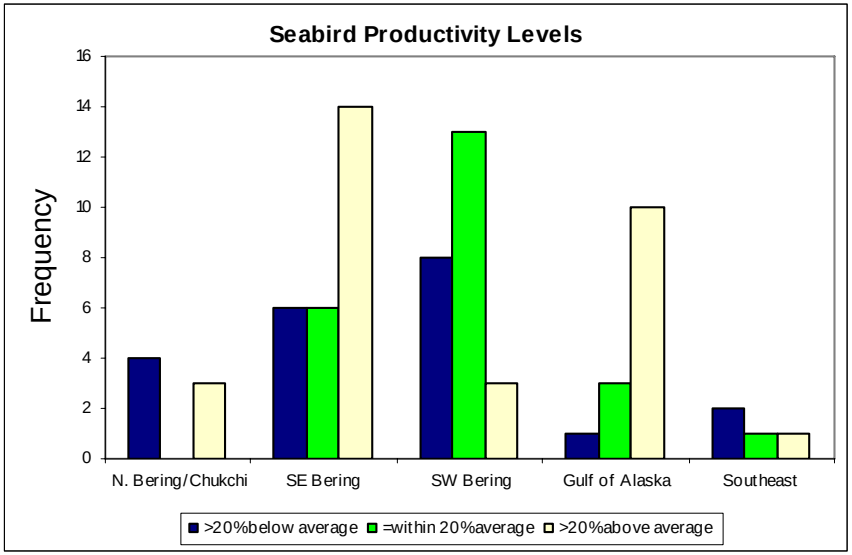
+++	X>2.7
++	2.7>X>1.6
+	1.6>X>0.5
.	0.5>X>-0.5
-	-0.5>X>-1.6
--	-1.6>X>-2.7
---	-2.7>X
	No data

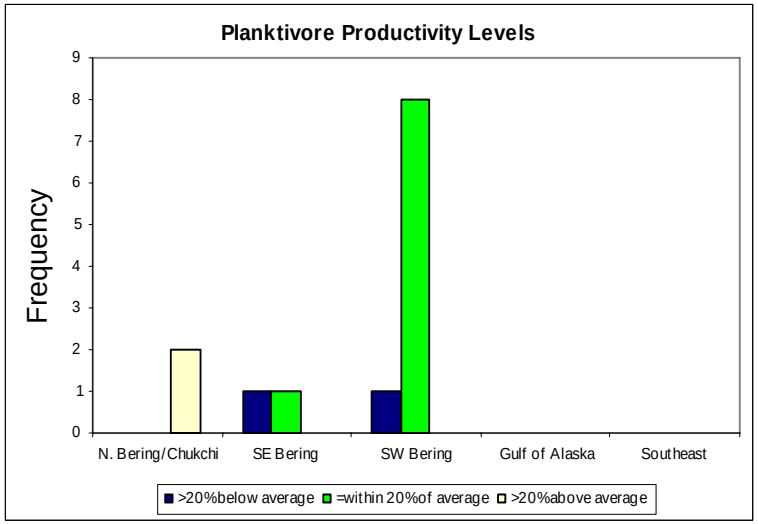
Table 25. Average productivity anomalies for seabird species averaged across colonies in three feeding guilds (surface piscivores (SP), diving piscivores (DP), and surface planktivores (PL)) of the GOA and SEAK. Anomalies were calculated as the estimated productivity for a given year minus the mean productivity over the whole time series and divided by the standard deviation. Anomalies were divided into 7 categories for display purposes (see legend).

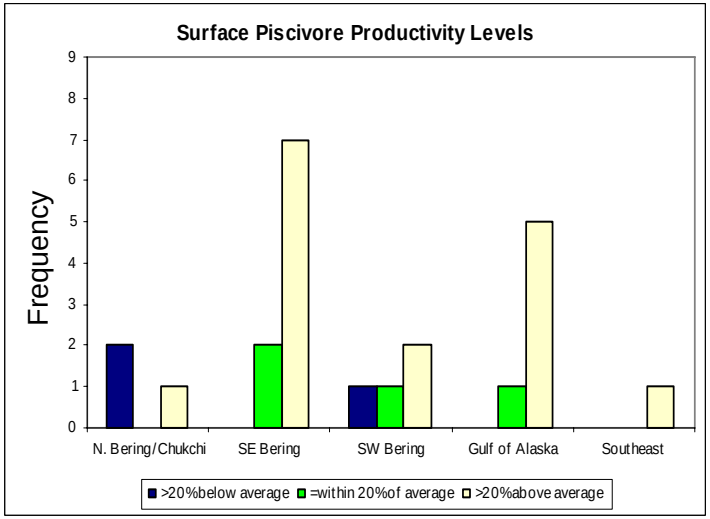
Region	Guild	Species	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
GOA	SP	BLKI				+	.	-		++	+	.	+	.	.	-	+	.	-	-	.	.	.	.	.	.	-	-	.	+	+
GOA	SP	GWGU																						.	.	-	+	.			+
GOA	DP	HOPU																							+	.	-	+			
GOA	DP	TUPU																				+	.	.	-	-	-	+			
GOA	DP	COMU						-	+	+								.	.	.	+	-	.	-	.	.	-	.	+	+	+
GOA	DP	TBMU						.	.	++								-	-	.	.	.		.			--			+	.
GOA	DP	PECO					.				++	++	+	+	-	-	-	-	.	.	-	+	-	-	.	.	.	.	+	+	+
GOA	DP	RFCO																-	-	.	-	+	+	-	+	-	-	-	+	+	+
GOA	DP	RHAU			+	-																.				-	.	+	+	+	-
SEAK	SP	GWGU																							-	.	.	-	-	+	+
SEAK	DP	TUPU																					-	--	+	+	.	.	.	.	
SEAK	DP	COMU																					+	-	-	+	.	-	.	+	-
SEAK	DP	TBMU																					.	.	-	++	-	-	+	+	.
SEAK	DP	PECO																					-	-	++	.	.	.	+	.	-
SEAK	DP	RHAU																									-			+	
SEAK	PL	FTSP																					++	.	+	.	.	--	.	.	
SEAK	PL	LHSP																					+	.	+	+	.	-	.	--	

Legend

+++	X>2.7
++	2.7>X>1.6
+	1.6>X>0.5
.	0.5>X>-0.5
-	-0.5>X>-1.6
--	-1.6>X>-2.7
---	-2.7>X
	No data







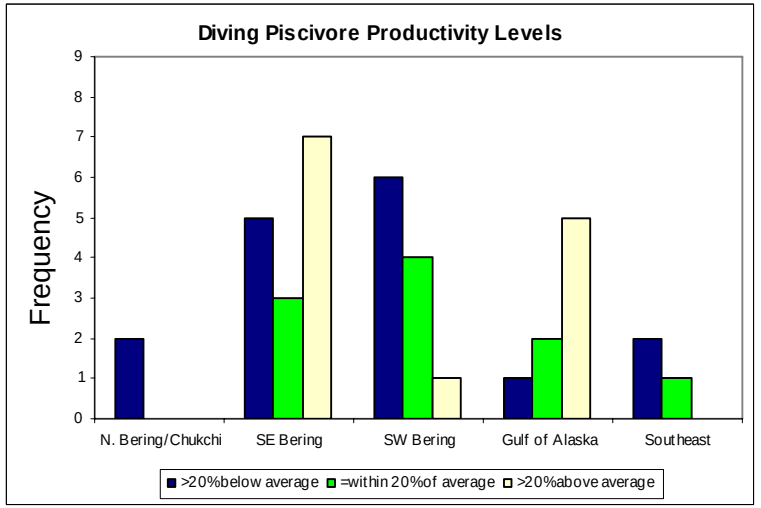


Figure 96. Seabird breeding success (by region and for three feeding guilds) for species monitored at selected colonies in Alaska in summer 2002. Frequency is the number of samples (species x site) for each region, showing below average, average, or above average productivity rates. Productivity was usually expressed as chicks fledged per egg (but see individual reports referenced in Dragoo et al. 2004 for variants). Data are from Table 38 in Dragoo et al. 2004.

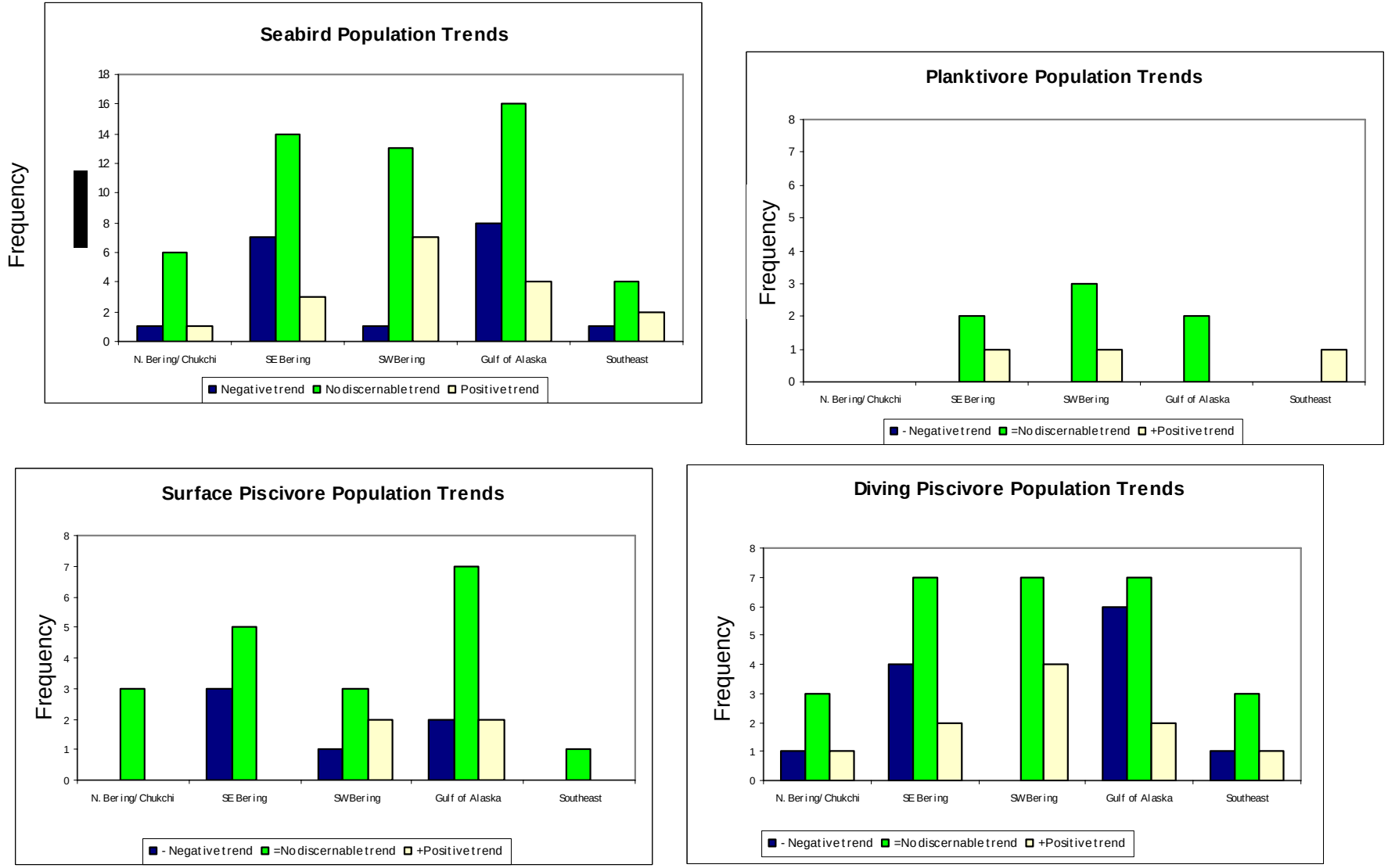


Figure 97. Seabird population trends (by region and for three feeding guilds) for species monitored at selected colonies in Alaska in summer 2002. Frequency is the number of samples (species x site) for each region, showing negative trends, no statistically significant trend, or positive trends in population, derived from exponential regression models for samples with multiple years of data. Data are from Table 39 in Dragoo et al. 2004.